MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

EME3276 – MECHANICAL DESIGN II
(ME)

24 OCTOBER 2017
2.30 pm – 4.30 pm
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 5 pages including cover page.

2. Attempt ALL questions.

3. Please write all your answers in the answer booklet provided. Show all relevant steps to obtain maximum marks.

4. You may use the appendices provided in the booklet.

Question 1

(a)   A helical compression spring with plain ends is to be designed with a scale of spring approximately 100 N/mm, and a spring index of 5. The spring is made of music wire with diameter of 10 mm. (Use Bergsträsser factor K_B in your calculations)

i. Find the maximum allowable shear stress of the wire.

[2 marks]

ii. Estimate the number of active coils.

[3 marks]

iii. Determine the maximum allowable static load.

[3 marks]

iv. Estimate the manufactured pitch so that the maximum allowable static load just compresses the spring to its solid length.   [4 marks]

(b)   A helical extension spring is made of hard-drawn wire with a mean coil diameter of 10 mm, a wire diameter of 2 mm, and 120 active coils. The hook radius is 6 mm (r_1=6 mm) and the bend radius is 3 mm (r_2=3 mm). The preload is 30 N and the free length is 264 mm.
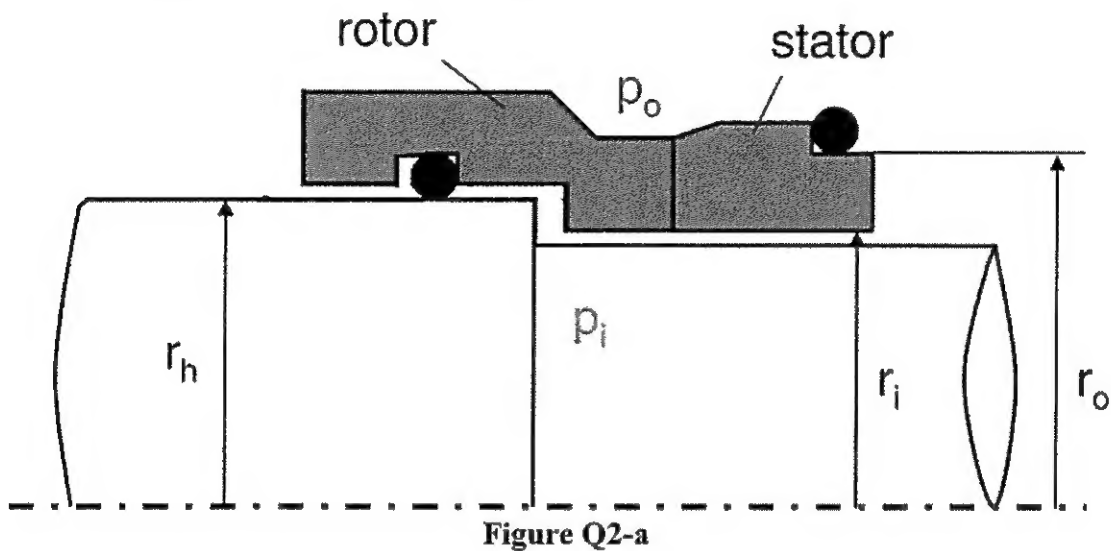
i. Find the spring rate.

[2 marks]

ii. Estimate the force required to cause the normal stress in the hook to reach the tensile yield strength.

[6 marks]

iii. Determine the force required to cause the torsional stress in the hook to reach the yield stress.   [5 marks]

Question 2

(a)   Two O-rings shown in **Figure Q2-a** should be mounted on the shaft with radius of r_h and on the stator with radius of r_o.

i. Determine the value of r_h and r_o if the O-ring internal diameters for these two location are 20 mm and 50 mm respectively, and desired stretch is 3%.   [**6 marks**]

ii. What is the recommended stretch for these O-rings and what are the consequences of stretch greater than recommended range.   [**3 marks**]

iii. Indicate four advantages of using O-ring.   [**6 marks**]

Figure Q2-a

(b)   Two B85 V belts are used in a drive composed of 5.4 in driving sheave, rotating at 1200 rev/min, and a 16 in driven sheave. Calculate the power capacity, H_{nom} of the drive based on service factor of 1.25 and find center-to-center distance.
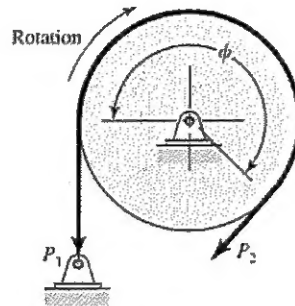
[**10 marks**]

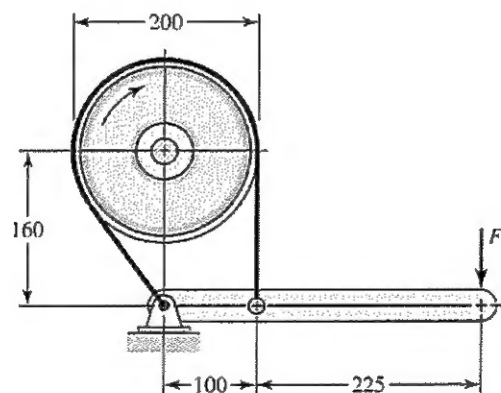**Continued ....**

Question 3

(a)   Determine **FIVE** characteristics of miscellaneous clutches and couplings.

[5 marks]

(b)   The drum brake shown in **Figure Q3-b** is 12 in in diameter. The band selected has a mean coefficient of friction of 0.28 and a width of 3.35 in. It can safely support a tension of 1800 lbf. If the angle of wrap is 270°, find the lining pressure and torque capacity.   **[8 marks]**
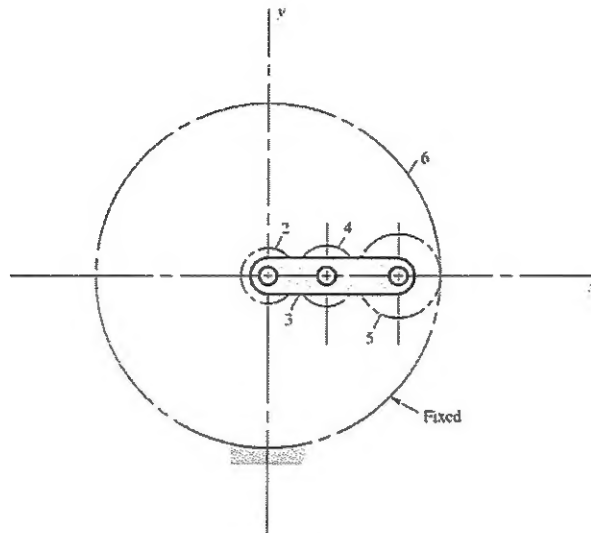

Figure Q3-b

(c)   The brake shown in **Figure Q3-c** has a coefficient of friction of 0.3 and is operated using a maximum force F of 400N. If the band width is 50 mm, find the band tensions and the breaking torque.

[12 marks]

Figure Q3-c

Continued.......

Question 4

(a)   The gears shown in the **Figure Q4-a** have a module of 12 mm and 20° pressure angle. The pinion rotates at 1800 rev/min clockwise and transmits 150 kW through idler pair to gear 5 on shaft c. Calculate the forces gear 3 and gear 4 transmit to the idler shaft. Given N2 =18T, N3=32T, N4 = 18T and N5 = 48T.

[15 marks]

Figure Q4-a

(b)   A steel spur pinion is to transmit 20 hp at a speed of 400 rev/min. The pinion is cut on the 20° full-depth system and has a diametral pitch of 4 teeth/in and 16 teeth. Find a suitable face width based on allowable stress of 12kpsi.

[10 marks]

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